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Comparison of kinetic models for predicting phosphate adsorption onto spent alum sludge in a continuous fixed-bed column

Yao-Sen Chen[a], Wei-Chin Chang[b]*, Shun-Hsing Chuang[c], Shih-Min Chiang[d]

[a]*Graduate School of Engineering Science and Technology, National Yunlin University of Science and Technology, Touliu, 640, Yunlin County, Taiwan*
Tel. +886 (5) 5342601 ext.4495; Fax +886 (5) 5312069; email: g9314206@yuntech.edu.tw
[b]*Department of Safety, Health and Environmental Engineering, National Yunlin University of Science and Technology, Touliu, 640, Yunlin County, Taiwan*
Tel. +886 (5) 5342601 ext.4422; Fax +886 (5) 5312069; email: changwc@yuntech.edu.tw
[c]*Department of Environmental Engineering and Management, Chaoyang University of Technology, Taichung County, Taiwan*
Tel. +886 (4) 23323000 ext.4447; Fax: +886 (4) 23742365; email: shchuang@mail.cyut.edu.tw
[d]*Bureau of Environmental Protection of Tainan County, Hsing-Ying, 730, Taiwan*
Tel. +886 (6) 6572916; Fax +886 (6) 6564105; email: smchiang@mail.tnceep.gov.tw

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ABSTRACT

This study attempted to examine the effectiveness of fixed bed adsorption for phosphate removal by spent alum sludge. Experiments with different bed depths were conducted to evaluate their effects on the column performance, where different breakthrough curves were obtained and thereby compared by kinetic models. Experimental data confirmed that expanding bed height could apparently increase the equilibrium phosphate uptake and hence lengthen both the breakthrough time and exhausting time. Spent alum sludge was concluded in this study to be successfully employed in fixed bed column for removing phosphate from aqueous solution. Furthermore, five kinetic models (Adams–Bohart, Thomas, Clark, Yoon–Nelson and bed-depth/service time analysis (BDST) models) were applied to experimental data to predict the breakthrough behavior and to determine the characteristic parameters of the column that are valuable for process design. Result indicated that both Thomas and Yoon–Nelson models described appropriately the whole breakthrough curves; whereas, BDST and Adams–Bohart models were merely suitable for fitting the initial stage of the same curves. Clark model, nevertheless, could not fit well with the experimental data.

Keywords: Breakthrough curve; Fixed-bed column; Phosphate adsorption; Alum sludge; Kinetic model

* Corresponding author.